Minnesota Board of Water & Soil Resources

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Field Assessment of Construction Components for Wetland Restorations

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Field Assessment of Construction Components for Wetland Restorations (22 pg)

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Introduction

Wetland restored using conservation funds in Minnesota.

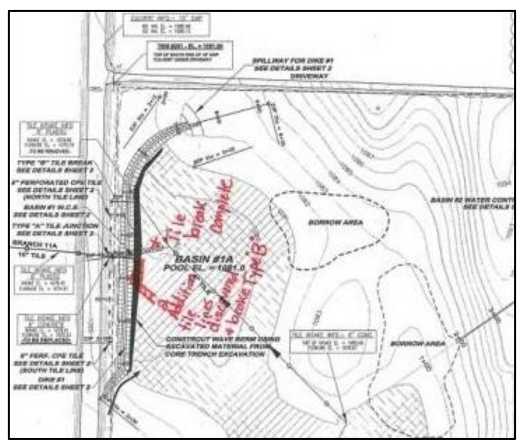
Throughout Minnesota, thousands of wetlands have been restored through conservation programs as well as for regulatory or replacement purposes. Monitoring and managing these restoration sites ensures that they continue to function and provide their intended benefits well into the future.

For many of these projects, a variety of strategies and construction measures were used to restore wetland hydrology and achieve specific design objectives. Constructed components could include but are not limited to: earthen embankments, ditch plugs, outlet structures, tile blocks, tile outlets, and drainage system re-routes. These components all require regular inspection. Due to the forces of nature and deterioration over time, constructed elements may require repair or replacement. With early detection, certain problems can be avoided altogether and life expectancy of these features can be extended.

The purpose of this document is to provide guidance on how to prepare for, conduct, and document findings for inspections of the types of construction components normally associated with wetland restoration projects. This guidance is targeted at the beginner to intermediate level natural resource practitioner who will be conducting inspections on behalf of the agencies or organizations that manage and oversee these projects.

The most common construction components will be discussed, along with typical problems to look for when inspecting them. A procedure is provided within the guidance on how to score or assess the condition of an identified component. Condition scores are part of the assessment to help program managers prioritize and plan for follow-up actions, should issues or problems be identified. Sample field forms and a quick reference table are also provided to aide in the inspection and assessment process.

Preparing for an Inspection



Portion of an as-built plan map.

Before heading into the field, gather specific information about the projects to be inspected. Review the project folder and find out what components were installed and where they are located. The best source for this information will be in the as-built construction plans or drawings. The 'as-builts' should provide specific information of each installed component including where they are located. If as-builts are not available, a copy of the original construction plan may be in the project folder. Because these plans can change during construction, they are not as reliable as as-built drawings.

Reviewing other materials in the project folder may be useful to become familiar with the restoration site, the installed components, and how they are expected to function. The project folder may also have notes or reports of prior-identified issues, concerns, or even repairs. A review of photos taken during or shortly after installation can provide an opportunity to see these features before they become inundated with water or overgrown with vegetation.

Discussions with local program staff and the easement owner may provide valuable information about the site or specific concerns or issues to focus on. Be sure to follow program policy on contacting landowners prior to accessing private lands.

Inspecting, Assessing, and Documenting Site Conditions

Pipe from a wetland's outlet structure that is well armored and appears to be in good condition.

The design of each restoration project is unique and dependent on a number of factors including how the wetland was drained or altered, type of wetland, site elevations, soils, property ownership, surrounding drainage features, contributing watershed area, and type and condition of the downstream outlet.

The purpose of inspecting installed construction components is to determine if they are properly functioning and being maintained. While landowners are expected to provide some level of routine inspection of their easements, they do not always have the training or experience to properly observe or understand issues that could potentially threaten or harm the integrity of their completed restorations.

Therefore, it is important for trained personnel to provide an extra level of attention through inspections of these restoration sites, in particular, those sites with installed construction components. While some issues will be minor and not require any immediate action, others can be more significant; if not properly addressed or corrected, these can cause harm or significant property damage. Obviously, the larger the wetland system, the greater the potential threat should these features fail. When inspecting, it is important to not only identify potential issues but also to score them in terms of severity.

The most common construction components installed on wetland restoration projects that require routine inspection and assessment include:

- Embankments/Ditch Plugs;
- Outlets (Trickle Drains, Culverts, Drop Inlets, Weirs, Vegetated or Armored Spillways);
- Drainage System Modifications (Tile Blocks, Tile Outlets, Drainage System Re-routes).

Beaver have plugged the opening of weir structure that is used to control wetland water discharges and water levels.

A discussion of the purpose of these components along with specific potential issues or concerns to watch for is included in this guidance document. Also included is a method to score the condition of installed components. Finally, a sample worksheet is provided that allows for documentation of the inspection results.

Scoring

There are a number of different issues or concerns that could be observed for an installed construction component; different levels of follow-up can be recommended for each concern. Five condition scores are available to document the observed condition or level of concern.

Score	Condition	Recommended Action	Follow Up Needed?
0	No concerns detected	None	No
1	Minor deterioration or problem identified. No maintenance or management action is required at this time.	Monitor	No
2	No deterioration detected but maintenance or management action such as reseeding, vegetation control, or debris removal is recommended or necessary.	Maintenance Required	Yes
3	Deterioration observed. Potentially could lead to component failure if not repaired. This is typically an isolated issue that does not require a complete reinstallation of the component.	Repair May be Necessary	Yes
4	Deterioration to degree that extensive repair or replacement is required.	Repair or Reinstallation Necessary	Yes

Providing Recommendations for Follow-up Activities

An important outcome of the inspection and scoring process is to help guide decisions for additional evaluations or maintenance work, either by the landowner or program staff. Findings from the initial review and assessment must be thorough and well documented: fill out evaluation forms completely, take photos, and identify the location of issues or problems that are discovered.

Inspectors with more experience may be able to discuss the cause of any identified problems as well as suggest specific corrective actions or methods of repair as part of their findings report. Others may only be able to identify where a potential problem exists, but be unable to determine the severity of the problem or solution to correct it.

Regardless, the evaluation, scoring, and written comments and observations should provide some sense of the severity of an identified issue, whether it can be taken care of through simple maintenance (tree and debris removal) or whether a follow up evaluation is needed by a qualified resource professional (muskrat damage to embankment or deterioration of an outlet structure).

EMBANKMENTS/DITCH PLUGS

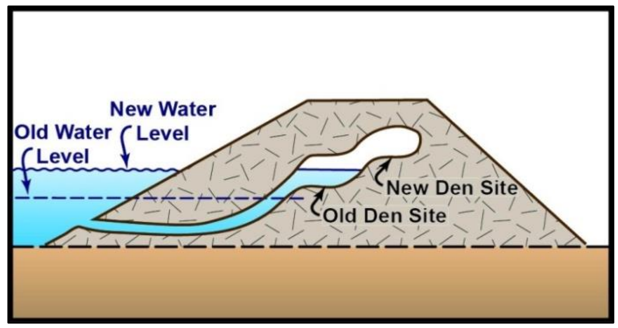
Embankments and ditch plugs are common on wetland restoration projects. They help restore and retain wetland hydrology and prevent flooding of adjacent properties. The continued function and integrity of these earthen structures is essential and they require frequent inspection.

Common problems associated with earthen structures include erosion, sloughing or excessive settling, and leaking or seeping. Causes of these problems can be improper vegetative cover, excessive wave action, burrowing rodents, poor or improper soils used in their construction, or poor construction technique. Problems can also occur from improper or untimely human use of the embankment, such a vehicular travel over wet or saturated embankment soils. Fortunately, most associated problems with earthen embankments and ditch plugs can readily be observed and, if detected early, corrected with minimal cost.

The following common issues should be the focus when inspecting earthen embankments and ditch plugs.

RODENT ACTIVITY:

Burrowing rodents such as muskrats and beaver cause significant damage to constructed earthen embankments and ditch plugs. Tunnels or dens may cause the collapse of surface soils and blow outs on the backside of the embankment. Beyond affecting immediate wetland hydrology, in some cases this can adversely impact downstream properties. Whether through tunneling or burrowing for den sites, unchecked rodent activity can become extensive and more expensive to correct the longer it continues. In some cases, re-construction of the entire embankment may be needed.



A typical muskrat den configuration within an embankment. Note how the den may expand and moves further into the embankment during periods of high water.

The best time to observe evidence of rodent burrowing is in the spring or fall when vegetation is less dense or during periods of low water. Collapsed runs or den sites may be encountered when walking on an embankment. The backside of the embankment may have evidence of running water or digging from skunks or other predators scavenging for muskrats.

As documentation, describe or map where the activity is occurring. If possible, stake, flag, or even use a GPS unit to note the coordinates of observed tunnels or dens. Note if water is observed running through these areas and leaking out on the backside of the embankment.

Some embankments may have been designed and constructed with measures to deter or prevent burrowing from muskrat or beaver. These measures can include fencing material, aggregate, or even concrete walls placed within the constructed earthfills. A close review of the design and construction plans should provide this information.

An embankment with moderate to severe muskrat damage. Photo was taken during a dry or drawdown period. Repair is likely necessary (condition score 3).

Significant muskrat damage within an embankment. Repair is necessary – condition score 4.

Poor or Improper Vegetative Cover:

The establishment of good vegetative cover along the slopes and crown of embankments and ditch plugs helps maintain the structural integrity of these earthen structures.

A good stand of vegetative cover will be weed free and contain a dense stand of grasses. Vegetation helps to stabilize the surface soils while also providing some structural strength to the embankment core. It helps protect the embankment surface from intense sun, wind, and rain.

Embankments with a poor stand of vegetation will be more likely to have issues with surface erosion or, in deeper open water wetlands, damage from wave action. Poorly vegetated embankments may be subject to less visible structural problems such as drying and cracking of embankment soils, which create problems with internal erosion and seepage. Left unchecked, these issues can lead to embankment failure. When inspecting embankments and ditch plugs, look for signs of cracking within the surface soils or seepage on the embankment's downstream slope or toe.

Although forbs and grasses are essential, woody vegetation must be cleared. Tree and shrub canopies shade out ground cover, preventing dense stands of grasses from establishing. All observed trees should be identified for removal and subsequent stump treatment to prevent regrowth.

Poor stand of grass on embankment. It needs to be re-seeded - condition score 2.

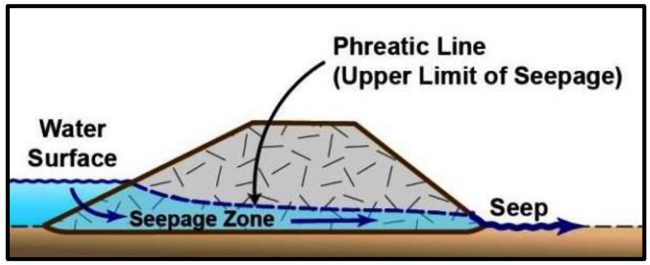
Cottonwood trees growing on upstream embankment slope toe. Maintenance is required - condition score 3.

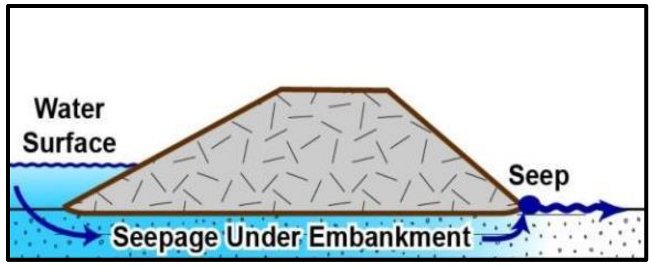
Moderate to severe embankment damage from wave action. Repair may be necessary - condition score 3.

Mature cottonwood trees growing on embankment. Note erosion of embankment soils due to tree roots. Tree removal and embankment repair - condition score 4.

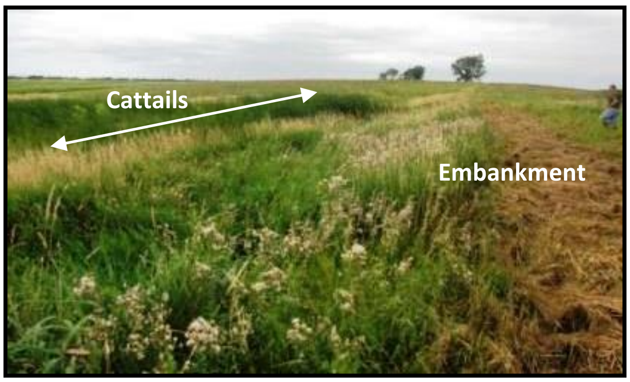
Seepage:

Earthen embankments are not impervious. With proper design, soils, and construction techniques, they should be relatively water tight and remain dry along their downstream toe. If improper soils or compaction techniques are used in their construction, seepage through the constructed fills may occur (pictured right). The degree of concern will depend on the rate of seepage and land use immediately downstream. Over time, excessive seepage can erode soil particles from within the embankment, potentially leading to complete failure of the structure.





To look for seepage, carefully examine the immediate downstream area, including the embankment toe. Look for signs of saturation or trickling water. Any evidence of seepage should be noted. For documentation, take photos and describe or map the location of the observed seepage. Also note the degree of saturation or inundation.



Seepage occurring downstream of embankment - note cattail growth. Wetland does not appear to be affected by the seepage loss and seepage area is fully contained within easement. Repair may be needed – condition score 3.

Seepage issue on downstream toe of embankment. Note standing water on downstream cropland. Repair is necessary - condition score 4.

Settling, Sloughing, and Other Issues:

Depending on the underlying soils and fills used, embankments can settle unevenly or can slough. These issues, if significant enough, will be a problem. Embankment tops should be level or of a consistent elevation. Embankment side slopes should be relatively uniform throughout the embankment's length. Look for signs of uneven settling (dips or sags along the top of embankment) or side slopes that have failed (fallen away from embankment).

Also note the condition of the embankment's surface. Embankments should have a slight crown to shed and prevent standing water on their surface. If used for vehicular travel or other human activities, look for deep ruts that can hold water and weaken the embankment. The depressions that result from ruts and settlement could collect water and drown out vegetation, or even result in water flowing over the embankment. For documentation, describe or map the location of the concern and take photos.

Deep ruts on embankment surface caused by excessive ATV use. Repair is likely needed – condition score 3.

SCORING - EMBANKMENTS/DITCH PLUGS

Concern	Score	Description of Condition
Rodent Activity	1	Extent of burrowing is limited.
	2	Burrowing activity potentially warrants some maintenance. Associated wetland is shallow and embankment is not threatened.
	3	Significant burrowing activity. Embankment surface has collapsed in areas.
	4	Significant burrowing activity. Embankment surface has collapsed in areas. Evidence of water seeping or leaking out backside of embankment.
Poor or Improper Vegetative Cover	1	Some evidence of sparse vegetative cover or limited toe erosion from wave action. The condition is not serious and may self-correct.
	2	Vegetative cover could be improved in limited areas.
	3	All or a majority of the vegetative cover needs reseeding or interseeding. Trees are establishing on embankment and need to be removed. Damage from wave action is more severe and may need corrective actions.
	4	Trees are well established and need removal. Extent of root establishment has or may eventually cause severe embankment erosion. Wave damage is severe and embankment integrity is compromised.
Seepage	1	Minor, isolated wet areas are observed. Not impacting any adjacent lands.
	2	Moderate seepage is occurring in limited areas. Not impacting any adjacent lands.
	3	Moderate seepage is occurring within a larger area. May be causing adverse impacts to adjacent lands.
	4	Significant seepage is occurring. Wetland pool elevations are not sustained. Flowing or ponded water is observed and/or adjacent lands are affected.
Settling, Sloughing, and Other Issues	1	Shallow depressions or ruts detected, but are well vegetated.
	2	Minor embankment settling has occurred. Minor damage to embankment surface has occurred through human use.
	3	Moderate embankment settling has occurred. Significant damage to embankment surface has occurred through human use. Water is ponding or has potential to pond on embankment surface.
	4	Severe embankment settling and/or sloughing of side slopes has occurred.

OUTLETS

An outlet is a general term used to describe a location or device where wetlands discharge runoff into downstream areas. Wetlands that are hydrologically isolated or that have little or no contributing drainage area may not have an outlet. However, when wetlands are influenced by groundwater flows or will receive runoff from a contributing drainage area, an outlet of some type should have been included as part of the design.

Outlets that control primary wetland discharges and regulate water levels are referred to as principal outlets. Principal outlets are used to manage and control wetland base flows in addition to most smaller runoff events. A secondary or emergency outlet is installed in combination with a principal outlet to discharge excess wetland outflows from larger runoff events.

While a variety of outlet types and configurations exist, six common types are used when restoring wetlands: trickle drains, culverts, drop inlets, weirs, vegetated spillways, and armored spillways. Each of these outlet types has a different design purpose and application. A close review of the design and construction plans should reveal the type and location of outlets installed on a project.

Trickle Drains:

Trickle drains are small-diameter conduits that range between 6 to 12 inches in diameter. They are used to manage wetland base flows and to protect companion vegetated spillways from potential prolonged discharges and saturation. Trickle drains provide additional flood detention storage or water quality benefits.

Trickle drains can be configured in a variety of ways with an outlet that is either free flowing or connected to a downstream subsurface tile drainage system. They can be installed as horizontal conduits through or around constructed embankments, through other elevated areas, or configured as simple, small-diameter drop-inlet structures. They are typically used in combination with other outlets.

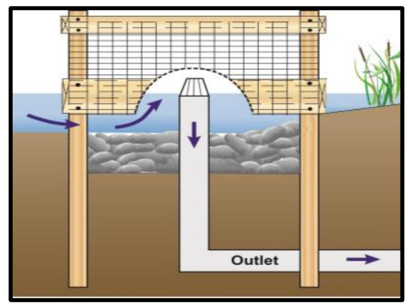


Diagram of simple trickle drain with trash rack and trash skimmer.

Culverts:

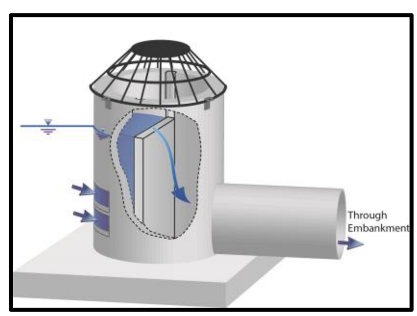
Horizontal pipe culverts are simple outlet structures used to control outflows and maintain wetland water levels. Culverts can be a variety of sizes, materials, and lengths depending upon the design needs of a project.

Horizontal pipe culverts can be newer structures installed through an embankment as part of a project; however, existing culverts through a roadway, ditch bank, or other earthen structure are occasionally used to serve as a wetland's outlet.


Entrance to a horizontal culvert through an embankment.

Drop Inlets:

Drop inlet structures are used to manage and convey wetland discharges to a stable, downstream conveyance system like subsurface tile or surface ditch drainage systems. Drop inlets can manage a wide range of discharges and are used in a variety of situations, so they vary in size, type, and material. Their basic design is a vertical riser pipe or some type of catch basin attached to a horizontal outlet pipe or barrel. They could include adjustable stop logs or gates to allow for management of wetland water levels.



Drop inlet structure with internal weir to control wetland water levels.

Weirs:

Weir structures are mechanical or constructed barriers that span open drainage ditches. They allow wetland discharges to flow over a fixed crest or vertical wall down to a stable outlet near the base of the structure. Weir structures are constructed with steel, vinyl, or other composite piling material or are cast in place as a reinforced concrete drop structure.

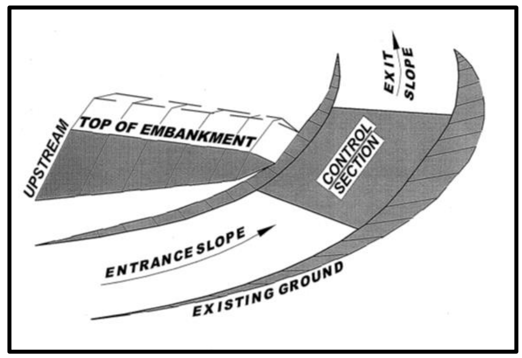
Weirs can have long, flat control sections that provide large discharges with relatively small stages or flow depths. Or, they can be multi-staged, with rectangular or v-shaped notches that provide controlled or metered flow rates at low stages of the wetland, yet allow larger discharges to occur at higher stages. Depending on materials used, weir structures may have adjustable stop logs or gates to allow for management of wetland water levels.

Steel weir wetland outlet structure.

Vegetated Spillways:

Vegetated spillways are wide, open channels, usually trapezoidal in shape. They are constructed to safely pass some or all of the expected wetland discharges.

Vegetated spillways can be used to control water levels and handle relatively large discharges compared to other types of outlets. They are regularly used as an emergency outlet in combination with another type of principal outlet. For many projects, though, a simple vegetated spillway alone may have been constructed to serve as the wetland's principal outlet.



Typical configuration of a constructed vegetated spillway.

Vegetated spillways will consist of an inlet channel, a control section, and an exit channel. The control section is constructed at some predetermined design elevation, either at the design wetland water surface when it functions as the principal outlet or at some higher elevation when it serves as an emergency outlet. Vegetated spillways are most often constructed around one or both ends of an embankment at the wetland's outlet.

Vegetated spillway after a large runoff event.

Armored Spillways:

Armored spillways are constructed in place of vegetated spillways where more frequent and longer duration flows exist. Armored spillways are also used where there may be extensive vehicular traffic crossing an overflow area.

Rock riprap is the most common material used when constructing these types of spillways. Other materials may include concrete or engineered synthetic products.

Manufactured concrete block armored spillway.

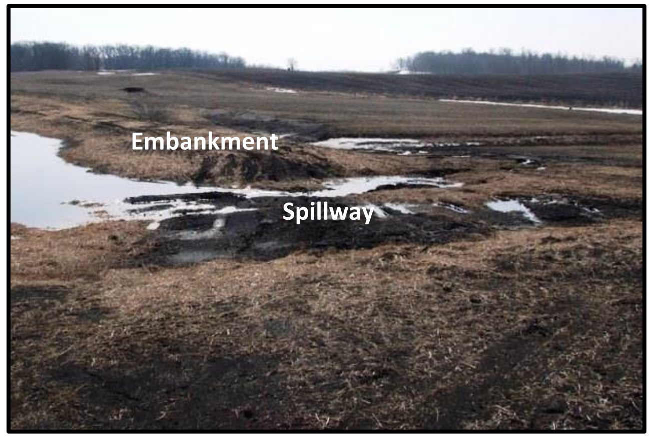
Common problems associated with constructed outlets include scouring at the outlet's entrance or exit, excessive settling or erosion of compacted earthfills, internal leaking, plugging by sediment or floating debris, or general failure of the structure. Causes of these problems vary depending upon the type of outlet and construction materials used. Some are caused by the forces of nature, others by animals, and others through simple deterioration of construction materials over time. Many of these problems can be avoided or corrected through routine maintenance.

When inspecting and assessing the condition of outlets, carefully describe any identified issue or concerns, indicate the severity of the issue or problem, and support the findings with photos.

The following common issues should be the focus when inspecting wetland outlets.

Soil Erosion or Scouring:

Although outlets are designed to manage and safely convey wetland discharges, they are subject to damage that can occur from the forces of nature, including the erosive forces of moving water. This can include scouring damage that occurs when water flows through vegetated spillways or at inlets and outlets of other structure types.



Example of a poorly graded vegetated spillway. Note concentration of flowing water along edge of embankment. Repair is likely needed – condition score 3.

Example of a vegetated spillway that has sparse vegetation but no scouring. Reseeding is likely necessary - condition score 2.

Scouring of vegetated spillways often occurs when the spillway has a poor stand of vegetation, is poorly graded and water ponds within its control section, or when it experiences flows that are just too high or long in duration. Evidence of this will be an eroded channel through the spillway's control section.

When inspecting vegetated spillways, determine if a dense stand of grass is established throughout its length. A dense stand of perennial grasses will stabilize the surface soils and allow the spillway to withstand periodic flows from the wetland. Excessive weedy plants could be a problem as they have shallower roots and may not survive prolonged flow events through the spillway. Trees and shrubs should not be allowed to establish within vegetated spillways; they can shade out desirable grasses and possibly impede flows.

Scouring can occur with other outlet structures, typically at inlets and outlets where flows and turbulence are the greatest. Pay close attention and determine if scouring has displaced extensive soil in these areas. If rock riprap or other armor material exists, determine if scouring and erosion of the underlying soils has displaced the rock riprap material and if additional riprap may be needed.

Example of a vegetated spillway that has excessive weed growth and is starting to scour. Repair is necessary - condition score 3.

Example of a minor scouring at pipe outlet - condition score 2.

Example of more severe scouring at pipe outlet. Repair is likely necessary - condition score 3.

Erosion can also occur in areas that are more difficult to detect. Outlet structures placed through embankments are subject to erosion of internal compacted soils along their length. This type of erosion often occurs along the outside surface of installed structures, in particular pipes or conduits. It can also occur around or under the outside edges of other structures such as weirs or armored spillways. While design and construction measures may have been taken to prevent this, it may still occur, often due to poor soil placement and compaction along these structures. To detect this, there may be obvious indicators such as partial or complete loss of compacted fills around or under the outlet. Less obvious indicators will be small flows that are occurring under or along the outside edges including the downstream end of installed conduits. This condition will be easier to detect if there are no normal discharges occurring through the pipe or structure. This type of erosion, if not corrected, can lead to more serious problems such as complete failure of the structure.

Evidence of settling or erosion along installed conduit. Repair is necessary – condition score 4.

Severe erosion of internal embankment soils along installed conduit. Repair is necessary – condition score 4.

PLUGGING OR BLOCKING:

Outlets are designed to function as free flowing structures able to pass wetland base flows and runoff from snowmelt and storm events. Unfortunately, when used in restored wetlands, many of these structures are highly susceptible to being blocked or plugged by floating debris, vegetation, and sediment. In addition, animals such as beaver and muskrat have a natural tendency to plug these structures when they have access to them.

Outlet is overgrown with wetland vegetation. Maintenance is necessary – condition score 2.

Outlet is overgrown with wetland vegetation. Maintenance is necessary – condition score 2.

Preventive measures may have been taken during design and construction to keep outlets functioning and reduce future maintenance needs. These measures include, but are not limited to, using guards, grates, trash skimmers, fence barriers, and drain filters. These prevent plugging or blocking by denying or limiting the ability for floating debris, sediment, or animals from accessing the structure. Nonetheless, routine inspection and maintenance are necessary to keep these devices and outlets functioning and clear of debris.

Many pipe structures will incorporate a trash rack or guard of some type that frequently needs to be cleared of vegetation and other debris. Other structures will utilize skimmer systems or other devices to prevent debris from entering the structure. These occasionally need to be cleaned and cleared of debris as well. Fortunately, most observed blockages can be simply corrected when inspecting the site. This includes safely removing trash or other debris that has collected around, on top, or in front of the structure’s entrances or exits. Be sure to document when and where blockages were found and cleared as part the site inspection.

Trash guard being cleared of vegetation and debris.

Weir structure plugged by beaver. Repair is necessary – condition score 4.

Certain blockages will be more difficult to detect or correct. These can include situations where beaver have plugged a structure, sediment has accumulated around an inlet or outlet of a structure, or when a piped structure has some type of internal blockage. When inspecting a pipe structure, try to determine if the pipe is free and clear of debris. One indication of a potentially plugged structure is if it is partially or fully submerged with little to no observed water flowing through or into it. Document the extent and cause of blockage, if known, when performing the site inspection.

Leaking:

Most outlet structures are intended to be water-tight. This includes the structure and any pipes that may be used as an outlet from the structure. Leaks in these structures could occur due to poor construction, defective materials, joint separation due to differential settlement of surrounding soils, etc. While minor leaks may not seem important, they can affect wetland hydrology or possibly lead to more significant issues including complete failure of the outlet structure.

Leaks are difficult to detect when water is discharging through or over a structure. They are best located when no water is entering the structure and leaks can be visibly seen or heard within it. A leak may also be suspected if no wetland flows are entering a structure yet discharges are observed at its outlet. If a leak is detected or suspected, attempt to identify and document its source.

Vertical seam in sheet pile weir structure has minor leak. Needs monitoring – condition score 1.

Stoplog seams are leaking. Maintenance or repair will be necessary – condition score 2.

Other Issues:

In addition to the items discussed above, a number of other factors can cause problems or lead to failure of an outlet. These typically relate to deterioration of structure materials but can also include vandalism, differential settling of graded fills around or above a structure, frost heaving, and ice damage.

In addition to natural products such as rock riprap, other materials used in the construction of wetland outlets include plastic, vinyl, metal, and concrete products. These materials will show wear and tear over time, and eventually may need repair or replacement. Thoroughly inspect outlets and make note of any signs of wear or deterioration. Some indicators are fissures, flaking, cracks, rust, and unexpected discoloration.

Weir structure appears to be failing. Repair will be necessary – condition score 4.

Culvert that has completely rusted through. Repair is necessary - condition score 4.

SCORING –OUTLETS

Concern	Score	Description of Condition
Soil Erosion or Scouring	1	Minor scouring observed.
	2	Moderate scouring observed.
	3	Significant scouring or erosion of soils around the outlet is observed. Rock riprap is being undermined or has been displaced.
	4	Major scouring or erosion of soils around the outlet. The outlet or components of the outlet have or are about to fail.
Plugging or Blocking	1	Minor plugging of trash racks, skimmers, rodent guards, or other filters cleared during the inspection.
	2	Trees or other vegetation are beginning to obstruct outlet.
	3	Outlet is partially plugged and needs clearing. Beaver activity requires routine clearing of outlet.
	4	Well established trees are obstructing an outlet. Outlet is fully plugged and cannot be cleared by hand.
Leaking	1	Minor leaking within structural components is observed. Likely not an issue – may seal on its own.
	2	Moderate leaking of structural components is occurring. Can possibly be corrected with minor repair or maintenance.
	3	Moderate to severe leaking is occurring within structural components. Could get worse without correction. May be causing adverse impacts to wetland hydrology.
	4	Significant leaking of structural components is occurring. Needs immediate attention or repair.
Other Issues	1	Minor issues or deterioration of outlet materials observed.
	2	Moderate issues are identified for which some maintenance or repair may be necessary.
	3	Significant issues have been observed that are affecting structure performance. Correction could increase life expectancy of outlet.
	4	Structure has failed or is about to fail.

DRAINAGE SYSTEM MODIFICATIONS

In addition to embankments, ditch plugs, and wetland outlets, a number of other construction strategies or components may have been implemented to modify existing drainage systems when restoring site hydrology. This includes tile blocks, tile outlets, and drainage system re-routes.

A close review of the design and construction plans should provide information about the use and location of these other construction strategies and features.

Tile Blocks:

A common strategy used to restore wetlands drained by subsurface drainage tile is to block and remove portions of the tile to render it inoperable. It is not necessary to remove the entire length of tile within the wetland to successfully restore optimum hydrology to most wetland systems. Instead, a single, well-placed tile block at the wetland's outlet will be all that is needed to abandon the desired reach of tile and achieve full hydrologic restoration. In other situations, multiple tile blocks may be required, such as in larger wetland complexes with varying or sloped topography.

Removing a section of tile to install a tile block.

The location and number of tile blocks needed, length of tile to be removed, methods to seal the tile ends, and methods to backfill and compact the excavated trench are the essential design and construction elements of this restoration strategy. If not done properly, issues with settling, erosion, and wetland leakage may result. It is most important to look for problems when tile blocks are constructed under embankments or through areas where overground flow occurs such as through a vegetated spillway.

Tile Outlets:

When subsurface drainage tile enters a restored wetland from upstream areas, it may have been necessary to provide a suitable, alternative means for the continued function of that upstream drainage system. This may have been accomplished by outletting the upstream tile into the restored wetland. This would likely have included a length of new tile installed at a flatter grade and different location than the old tile.

Constructed tile outlet (CMP) with rodent guard and rock riprap.

The tile outlet should be well protected to safely accommodate discharges from the upstream drainage system. The outlet will likely include a short sleeve of corrugated metal pipe (CMP) with a hinged rodent guard attached to it. It may also include a small amount of rock riprap to prevent scouring.

Drainage System Re-Routes:

Restoration construction may have included the re-routing of upstream drainage systems around or away from the restored wetland. This re-routing could be subsurface drainage tile or, in some cases, an open ditch system. These components only need inspection when located within the easement boundary. If they were installed on adjacent lands, it will typically be the responsibility of that neighboring landowner to maintain their part of the re-routed drainage system.

Installing subsurface draintile to re-route a tileline.

Common problems associated with construction strategies used to modify drainage systems include erosion, scouring or sloughing of site soils, failure of plugs or tile joints, issues with beaver on open ditch systems, or general failure or collapse of installed subsurface tile systems. Most problems result from poor construction methods or installation techniques.

Some problems can be avoided or corrected through routine maintenance. Most, however, will require some type of repair or re-construction.

When inspecting and assessing the condition of these other construction components, carefully describe any identified issue or concerns, indicate the severity of the issue or problem, and support the findings with photos.

The following common issues should be the focus when inspecting these other construction components.

Soils Erosion, Scouring, or Sloughing

Erosion and scouring can occur at tile outlets, over areas where tile blocks have been constructed, or at areas where drainage systems have been diverted or re-routed. Pay close attention to these areas and look for signs of erosion, scouring, channeling, etc.

Also look for signs of head-cutting or sloughing of side slopes when inspecting constructed channels or ditches.

Significant scouring of a constructed overflow channel. Repair is necessary – condition score 4.

Minor erosion occurring between constructed tile outlet and restored wetland. Repair may be needed – condition score 2.

Channelized flow occurring through spillway area where a tile block was performed. Excessive settling within the tile removal trench has channelized flow and caused some scouring. Repair may be necessary – condition score 3.

Failed Plugs or Tile Joints:

At locations where tile blocks were constructed or where a junction with an existing tile system was made, a potential exists for the block or junction to fail. This results in surface soils and possibly even wetland hydrology entering the functioning downstream tile system. If not repaired, bigger issues with sedimentation and plugging of the downstream tile system will result.

A failed plug at downstream end of a constructed tile block. Downstream tile is pulling sediment into it, forming a sinkhole. Repair is necessary – condition score 4.

Settlement of soils within tile removal trench allowing water to pond. Repair recommended – condition score 3.

A failed tile joint on a re-routed tile system. The downstream tile is pulling sediment into it, forming a sinkhole. Repair is necessary – condition score 4.

Other Issues:

Both existing as well as constructed channels and ditches can be compromised by beaver dams. Inspect for presence of beaver and beaver dams at all locations where channels, swales, or ditches exist.

A beaver dam constructed across diversion ditch. Repair is necessary - condition score 4.

SCORING - DRAINAGE SYSTEM MODIFICATIONS

Concern	Score	Description of Condition
Soil Erosion, Scouring or Sloughing	1	Minor scouring observed.
	2	Moderate scouring observed.
	3	Significant scouring or erosion of soils is observed. Rock riprap is being undermined or has been displaced.
	4	Major scouring or erosion of soils has occurred.
Failed Plugs or Tile Joints	1	Not applicable.
	2	Not applicable.
	3	Minor settlement identified by slight depressions, with or without standing water.
	4	Sink holes identified or large depressions.
Other Issues	1	Beaver activity noticed on surrounding vegetation, but no evidence of damming.
	2	Moderate damming of channel, diversion ditch, etc.
	3	Dams identified; water levels potentially impacting neighboring properties.
	4	Dams identified; impacts to structures and/or neighboring properties.

INSPECTION OF CONSTRUCTION COMPONENTS FOR WETLAND RESTORATIONS

Program:	**County:**	**Date:**
Project ID # :	**Township – Section – Range:**	**Landowner(s) Present? :**
Inspector (s):		**Affiliation(s):**

Materials reviewed: ☐ **As-built and/or Construction Plan** ☐ **Other** ☐ **None Found***

*If none found, a sketch should be developed identifying type and location of components.

Additional notes and details of concerns identified on reverse side:

Attachments: ☐ **Photos** ☐ **Map** ☐ **Coordinate Table** ☐ **Other**

Instructions: Check box for each issue observed. Then describe the location (map area) and score (severity) for that issue. Record the location with a GPS unit if the issue may be difficult to re-locate. After all components are inspected, write the highest score (reflecting the most severe condition) for each component type in the 'Score' column.

Component		**Score**	**Issue(s)**	**Map Area & Score**
	Embankments/ Ditch Plugs		☐ rodent activity ☐ poor or improper vegetative cover ☐ seepage ☐ settling or sloughing ☐ other	
Outlets	Trickle Drains		☐ soil erosion or scouring ☐ plugging or blocking ☐ leaking ☐ other	
	Culverts		☐ soil erosion or scouring ☐ plugging or blocking ☐ leaking ☐ other	
	Drop Inlet		☐ soil erosion or scouring ☐ plugging or blocking ☐ leaking ☐ other	
	Weir		☐ soil erosion or scouring ☐ plugging or blocking ☐ leaking ☐ other	
	Vegetated Spillway		☐ soil erosion or scouring ☐ plugging or blocking ☐ leaking ☐ other	
	Armored Spillway		☐ soil erosion or scouring ☐ plugging or blocking ☐ leaking ☐ other	
Drainage System Modifications	Tile Block		☐ soil erosion, scouring, or sloughing ☐ failed plugs or tile joints ☐ other	
	Tile Outlets		☐ soil erosion, scouring, or sloughing ☐ failed plugs or tile joints ☐ other	
	Drainage System Re-routes		☐ soil erosion, scouring, or sloughing ☐ failed plugs or tile joints ☐ other	

Scores

N/A = Not present	2 = Minor maintenance or management required
0 = No problem detected	3 = Repair may be necessary (moderate deterioration)
1 = Monitor (minor deterioration or problem)	4 = Repair or reinstallation required (significant deterioration or failure)

v. April 2014

Optional Table of Coordinates for Issues Identified:

Component	Issue	X or longitude	Y or latitude

Geographic Coordinate System:

☐ Geographic Coordinate System (latitude and longitude)

☐ Universal Transverse Mercator System

☐ Zone 14

☐ Zone 15

Datum ____